Claim 3: Communicating Reasoning

The Smarter Balanced summative mathematics assessment and its relationship to instruction

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What is Claim 3?

- Assesses students' ability to clearly and precisely construct viable arguments to support their own reasoning and critique the reasoning of others.
- Somewhat similar to Washington's short-answer items.
- Uses multiple item types in new assessment

More Information

- More information about communicating reasoning for Claim 3 is available online in the Mathematics Content Specifications.

Claim 3 requires use of content in the Standards

- Communicating reasoning is critical for solid mathematical understanding.
- It provides a firmer foundation for future learning than just knowing a procedure.
- Claim 3 focuses on a particular standard or part of the standard.

Examining a standard

- 4.NF.A.2
  - Compare two fractions with different numerators and different denominators, e.g., by creating common denominators or numerators, or by comparing to a benchmark fraction such as ½. Recognize that comparisons are valid only when the two fractions refer to the same whole. Record the results of comparisons with symbols >, =, or <, and justify the conclusions, e.g., by using a visual fraction model.

Domains

Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	High School	High School
3.OA.B	4.OA.3	5.NBT.2	6.RP.A	7.RP.2	8.EE.1	N-RN.A	F-IF.5
3.NF.A	4.NBT.A	5.NBT.6	6.RP.3	7.NS.A	8.EE.5	N-RN.B	F-IF.9
3.NF.1	4.NBT.5	5.NBT.7	6.NS.A	7.NS.1	8.EE.6	N-RN.3	F-BF.3
3.NF.2	4.NBT.6	5.NF.1	6.NS.1	7.NS.2	8.EE.7a	A-SSE.2	F-BF.4a
3.NF.3	4.NF.A	5.NF.2	6.NS.C	7.EE.1	8.EE.7b	A-APR.1	F-TF.1
3.MD.A	4.NF.1	5.NF.B	6.NS.5	7.EE.2	8.EE.8a	A-APR.B	F-TF.2
3.MD.7	4.NF.2	5.NF.3	6.NS.6		8.F.1	A-APR.4	F-TF.8
	4.NF.3a	5.NF.4	6.NS.7		8.F.2	A-APR.6	G-CO.A
	4.NF.3b	5.NF.7a	6.EE.A		8.F.3	A-REI.A	G-CO.B
	4.NF.3c	5.NF.7b	6.EE.3		8.G.1	A-REI.1	G-CO.C
	4.NF.4a	5.MD.C	6.EE.4		8.G.2	A-REI.2	G-CO.9
	4.NF.4b	5.MD.5a	6.EE.B		8.G.4	A-REI.C	G-CO.10
	4.NF.C	5.MD.5b	6.EE.6		8.G.5	A-REI.10	G-CO.11
	4.NF.7	5.G.B*	6.EE.9		8.G.6	A-REI.11	G-SRT.A
		5.G.4*			8.G.8	F-IF.1	G-SRT.B

*Denotes additional and supporting clusters

Claim 3 is based on the Mathematical Practices

- Mathematical Practices 3 and 6 are foundational support for Claim 3.
  - 3. Construct viable arguments and critique the reasoning of others.
  - 6. Attend to precision.

Additional information on Claim 3 and the Mathematical Practices

- The Smarter Balanced Content Specifications, with additional information on how these practices inform Claim 3, is available online.

Communicating Reasoning: A variety of skills

- Claim 3 has seven targets, with the last target reserved for later grades.
- The six targets are the same at each grade level.
- Each target describes a particular skill that should be developed in students as part of the ability to communicate and reason about mathematical ideas.
- Most items assess more than one target.

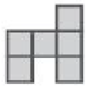
Target A: Test propositions

- *Test propositions or conjectures with specific examples.*
- Tasks used to assess this target ask for specific examples to support or refute a proposition or conjecture.

Test a Proposition

- Grade 5

William used 6 squares to make the figure shown.

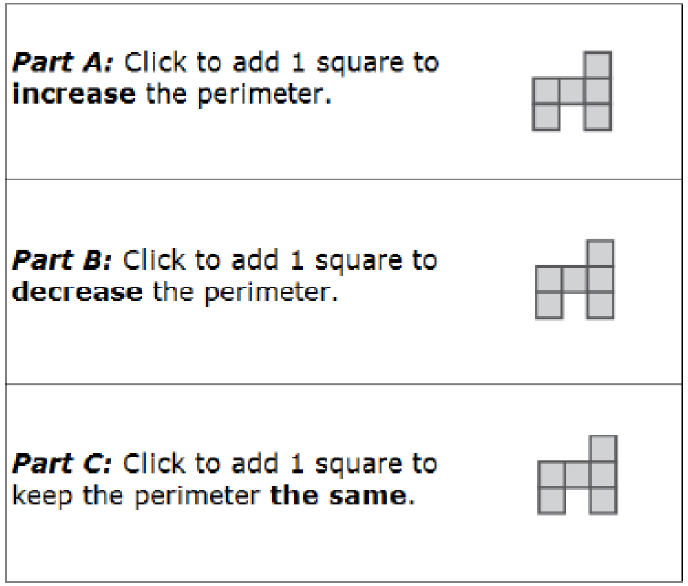


He claims that he can **add exactly 1 more** square to this shape to:

Part A: increase the perimeter.

Part B: decrease the perimeter.

Part C: keep the perimeter the same as the original perimeter.

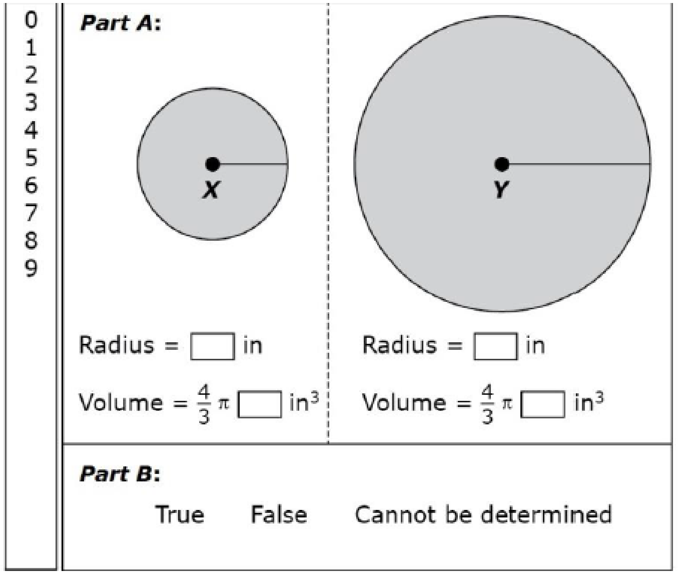


- High School

The radius of sphere *Y* is twice the radius of sphere *X*. A student claims that the volume of sphere *Y* must be exactly twice the volume of sphere *X*.

Part A: Drag numbers into the boxes to create one example to evaluate the student's claim.

Part B: Decide whether the student's claim is True, False, or whether it Cannot be determined. Select the correct option.



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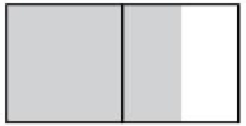
Target B: Justify or refute propositions or conjectures

- *Construct, autonomously, chains of reasoning that will justify or refute propositions or conjectures.*
- "Autonomous" in this target means students respond to a single question without further guidance.
- Target B has less scaffolding that Target A.

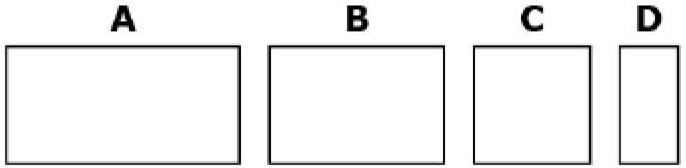
Chains of Reasoning

- Grade 5

Look at the fraction model shown.

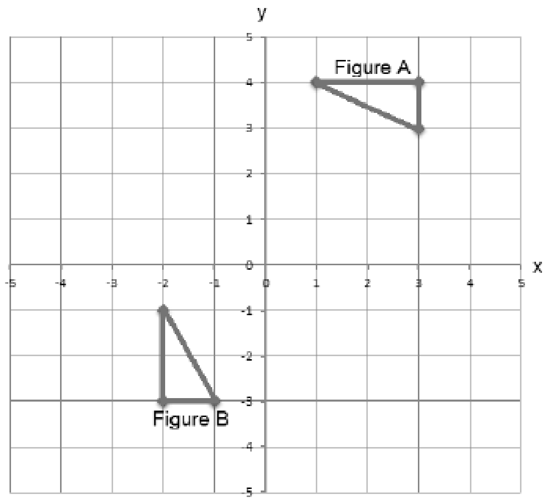


The shaded area represents $\frac{3}{2}$. Robert claims that the only way to model $3 \times \frac{3}{2}$ using rectangles A, B, C, and D is to use 3 of rectangle B. Drag rectangles to the answer space to construct a model to show that Robert's claim is incorrect.



- Grade 8

Two figures are shown on the coordinate grid.



Prove that Figure A and Figure B are congruent.

Describe three single transformations that, when performed, would transform Figure A to Figure B. In your response, be sure to identify the transformations in the order they are performed.

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Target C: State logical assumptions

- *State logical assumptions being used.*
- Students may be asked to identify the assumption, or they may be asked to use an assumption to answer a question.

Assumptions

- Grade 4

Carl estimates it will take him about 1 hour to run 5 miles.

What assumption did Carl use to make his estimation?

A. He can run 2 miles in 30 minutes.
B. He can run 3 miles in 30 minutes.
C. He can run 1 mile in about 10 minutes.
D. He can run 1 mile in about 12 minutes.

- High School

Drag values for l and w into the boxes to make the paired statements true for both $l \cdot w$ and $l + w$.

If none of the values make both statements true, leave the boxes empty for that pair of statements.

	Statements	Example
3 5	$l \cdot w$ is an irrational number $l + w$ is a rational number	$l =$ ☐ $w =$ ☐
$\sqrt{3}$ $\sqrt{5}$	$l \cdot w$ is a rational number $l + w$ is an irrational number	$l =$ ☐ $w =$ ☐
$3\sqrt{5}$ $5 - \sqrt{3}$	$l \cdot w$ is an irrational number $l + w$ is an irrational number	$l =$ ☐ $w =$ ☐

Target D: Breaking an argument into cases.

- *Use the technique of breaking an argument into cases.*
- Students look for conditions that make an argument true and those that show an argument is not true.

Cases

- Grade 7

Select the **two** statements that are true in **all** cases.

Statement 1: The greatest common factor of two distinct prime numbers is 1.
Statement 2: The greatest common factor of two distinct composite numbers is 1.
Statement 3: The product of two integers is a rational number.
Statement 4: The quotient of two integers is a rational number.

- High School

A student examines two graphs representing functions $y = f(x)$ and $y = g(x)$. The student notices that the graphs of the functions $f(x) = x + 5$ and $g(x) = x^2 + 5$ both have a y-intercept at the point (0, 5). The student makes the following claim:

"For any constant c, the location of the y-intercepts for the graphs of $c \cdot f(x)$ and $c \cdot g(x)$ is the same point."

Show that this claim is true by giving the y-value, in terms of c, of the ordered pair (0, ?) that represents the y-intercept for the graphs of $c \cdot f(x)$ and $c \cdot g(x)$.

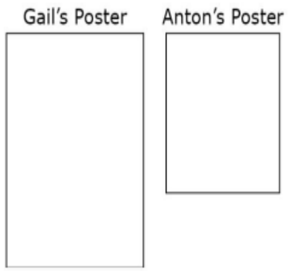
Target E: Correct or flawed reasoning

- *Distinguish correct logic or reasoning from that which is flawed, and if there is a flaw in the argument, explain what it is.*
- Finding flaws in arguments helps students develop their own correct reasoning.

Argument and Error

- Grade 3

Gail and Anton each paint $\frac{1}{2}$ of a poster.



Gail says that the painted portion of her poster is bigger than the painted portion of Anton's poster. Anton says the painted portions of both posters are the same size.

Which student is correct? Click on Gail or Anton.

Gail | Anton

Click on the statement that explains why the student you selected is correct.

A. Both fractions are the same number and refer to painting a poster.
B. The posters have to be the same size for $\frac{1}{2}$ to be the same size on both.
C. Since $\frac{1}{2} = \frac{1}{2}$, the amount of each poster covered with paint is the same.

- Grade 8

Kyle had to solve a problem. The problem and his work are shown in the box.

Select the part of Kyle's work that has a mistake.

Select the part of the problem Kyle should read again to fix his mistake.

A company sells baseball gloves and bats. The gloves regularly cost $30 and the bats regularly cost $90. The gloves are on sale for $4 off. The bats are on sale for 10% off. The goal is to sell $1200 worth of bats and gloves each week. Last week, the store sold 14 gloves and 9 bats.

Did the store meet its goal?

1.	2.	3.
$30 − $4 = $26	$90 ÷ 0.9 = $100	$900 + $364 = $1264
$26 × 14 = $364	$100 × 9 = $900	

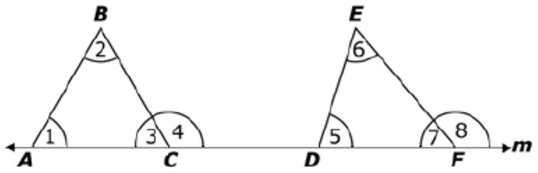
Target F: Arguments based on concrete referents

- *Base arguments on concrete referents such as objects, drawings, diagrams, and actions.*
- Students may be asked to use a drawing or diagram to support or refute a conjecture.
- In later grades, concrete referents will often support generalizations as part of the justification of an argument.

Referents

- Grade 8

The base of triangle *ABC* and the base of triangle *DEF* lie on line *m*, as shown in the diagram.



not drawn to scale

The measure of $\angle 4$ is less than the measure of $\angle 8$. For each comparison, select the symbol ($<$, $>$, $=$) that makes the relationship between the first quantity and the second quantity true.

First Quantity	Comparison	Second Quantity
$m\angle 3$	$<$ $>$ $=$	$m\angle 7$
$m\angle 1 + m\angle 2$	$<$ $>$ $=$	$m\angle 5 + m\angle 6$

- High School

Ashley claims that when you multiply two different **square roots** together, the product is always **rational.** For example, $\sqrt{2}\cdot\sqrt{18}=\sqrt{36}=6$ and $\sqrt{3}\cdot\sqrt{27}=\sqrt{81}=9$.

She also claims that that when you multiply two different **cube roots** together, the product is always **irrational.** For example, $\sqrt[3]{2}\cdot\sqrt[3]{18}=\sqrt[3]{36}\approx 3.3019$ and $\sqrt[3]{3}\cdot\sqrt[3]{27}=\sqrt[3]{81}\approx 4.3027$

Which statement correctly classifies Ashley's claims and provides appropriate reasoning?

A. Ashley is correct because her examples support both claims.

B. Ashley is correct about the product of square roots always being rational, but the product of cube roots can sometimes be rational.

C. Ashley is incorrect about the product of square roots always being rational, but she is correct that the product of cube roots is always irrational.

D. Ashley is incorrect because sometimes the product of square roots can be irrational, and sometimes the product of cube roots can be rational.

Target G: Determine conditions of an argument

- *At later grades, determine conditions under which an argument does and does not apply. (For example, area increases with perimeter for squares, but not for all plane figures.)*
- Often these tasks ask students to determine whether a proposition or conjecture always applies, sometimes applies, or never applies.

Changing Conditions

Grade 7

Determine whether each statement is true for all cases, true for some cases, or not true for any case.

Statement	True for all	True for some	Not true for any
Two vertical angles form a linear pair.			
If two angles are supplementary and congruent, they are right angles.			
The sum of two adjacent angles is 90º.			
If the measure of an angle is 35°, then the measure of its complement is 55°.			
The measure of an exterior angle of a triangle is greater than every interior angle of the triangle.			

High School

An inequality is shown below.

$\sqrt[8]{m} \leq m$

Part A:
Determine the positive values of *m* for which the inequality is **true**.
Enter your response as an inequality in the first response box.

Part B:
Determine the positive values of *m* for which the inequality is **false**.
Enter your response as an inequality in the second response box.

More information on Claim 3 assessment

- More example items for each target are available online in the Claim 3 item specifications.
  - Begin by selecting a grade to explore, then select mathematics. Finally select the claim to explore.

How Claim 3 informs assessment

- Students will reason about the central mathematical ideas in the standards.
- Students must go beyond recall and application of concepts and procedures.
- They will use evidence to support their thinking.
- Approximately one-fifth of the Smarter Balanced CAT and performance task assessments will consist of Claim 3 items.

More information on Claim 3 assessment: Round 2

- More information on Claim 3 on the summative assessment, both the computer-adaptive and the performance task portions, is available online in the Test Blueprints.

How Claim 3 informs instruction

- Students must be given opportunities to communicate reasoning.
- Claim 3 lends itself to a collaborative, open classroom.
- The classroom environment is richer than a summative assessment can be.
- Questions need to promote deep thinking.

Further help

- Specific Claim 1, 2, and 4 videos are available on the website to get a more complete picture of each claim and the skills students should develop through focused instruction.